09-25-00

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ASSISTANT COMMISSIONER FOR PATENTS

Box Patent Application

Washington, D. C. 20231

Sir:

Transmitted herewith for filing under 37 CFR 1.53(b) are the specification and claims of the nonprovisional patent application of:

Naoki TUMURA _____ for

Inventor(s)

A COMMUNICATION TERMINAL AND FACSIMILE APPARATUS CONNECTED TO AN ANALOG
COMMUNICATION NETWORK AND PROVIDED WITH A POWER MANAGEMENT FEATURE

Title of Invention

APPLICATION ELEMENTS ENCLOSED:

1. __X__ Specification (total pages __33__ including:

    a.   __10__ pages of claims (15 claims)

    b.   __1__ page(s) Abstract

2. __X__ __5__ sheets of ____ informal __X__ formal drawings (Figs. 1-5)

3. __X__ Oath or declaration of Applicant(s) (3 total pages)

    a.   ____ Newly executed (original)

    b.   __X__ Unexecuted

    c.   ____ Copy from a prior application (37 CFR 1.63(d))

        (for continuation/divisional with Item 14 completed)

4. ____ Deletion of Inventor(s)

Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b)

5. ____ Incorporation By Reference

The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied in item 3b is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ____ Microfiche Computer Program (Appendix)

APPLICATION PARTS ENCLOSED:

7. ____ An assignment of the invention to _____(cover sheet & document(s))

8. ____ 37 CFR 3.73(b) Statement *(when there is an assignee)*

9. __X__ Power of Attorney

    a.   ____ Newly executed (original)

    b.   __X__ Unexecuted

    c.   ____ Copy from a prior application

10. _X_ Information Disclosure Statement (IDS)/PTO-1449

    _X_   Copies of IDS Citations

11.___   A Preliminary Amendment

12._X_ Return Receipt Postcard (MPEP 503)

13.___ A small entity statement under 37 C.F.R. §1.9 and §1.27

    ____   Statement filed in prior application, status still proper and desired

14.___ If a Continuing Application, *check the appropriate box and supply the requisite information*:

    ☐   Continuation of prior application No.: _____ filed _____

    ☐   Divisional of prior application No.: _____ filed _____

    ☐   Continuation-in-part (CIP) of prior application No.: _____ filed _____

15.___ Amend the specification by inserting before the first line of page one: --This is a __continuation ____ divisional of application Serial No. _____ filed ___.--

16._X_ Priority of application No. _11-269366_ filed in _Japan_ on _September 22, 1999_. Applicant hereby claims priority under 35 U.S.C. § 119.

    _X_   A certified copy of priority application No. _11-269366_ is enclosed.

    ___   A certified copy of priority application No. _____ has been filed in prior application S.N. _____ filed _____

17.___ Other (identify) _____

     The filing fee is calculated as follows:

CLAIMS AS FILED, LESS ANY CLAIMS CANCELLED BY AMENDMENT

	Number Filed		Number Extra*		Rate Small Entity	Rate Other Entity		Fee Small Entity	Fee Other Entity
Total Claims	15 - 20	=	0	x	$ 9	$ 18	=	$ 0	$ 0
Indep. Claims	5 - 3	=	2	x	$ 39	$ 78	=	$ 0	$ 156
Multiple Dependent Claims Presented: Yes____ No _X_					$130	$260	=	$ 0	$ 0
If the difference in column 1 is less than zero, enter "0" in column 2				Basic Fee			$ 345	$ 690	
					Total Fee			$	$ 846

18._X_ A check in the amount of $ _846.00_ to cover the filing fee.

19.___ A check in the amount of $____for recordation of the Assignment.

20._X_ The Commissioner is hereby authorized to charge any additional fees which may be required in connection with the following or credit any overpayment to Deposit Account No. _03-3125_.

    _X_   Filing fees under 37 C.F.R. § 1.16.

    _X_   Patent application processing fees under 37 C.F.R. §1.17.

    ____   The issue fee set in 37 C.F.R. §1.18 at or before mailing of the Notice of Allowance, pursuant to 37 C.F.R. §1.311(b).

21._X_ Three copies of this sheet are enclosed.

22.___ Other (identify) _____

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Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: Naoki TUMURA

Serial No.   :   Group Art Unit:

Date Filed   :   Concurrently Herewith   Examiner:

For   :   A COMMUNICATION TERMINAL AND FACSIMILE
                    APPARATUS CONNECTED TO AN ANALOG
                    COMMUNICATION NETWORK AND PROVIDED WITH A
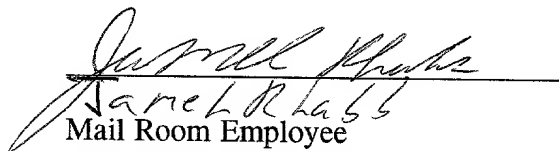   POWER MANAGEMENT FEATURE

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Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

EXPRESS MAIL
LETTER OF TRANSMITTAL

Express Mail mailing label number:_EL628790225US_

Date of Deposit: _____September 22, 2000_____

I hereby certify that the above-identified application (consisting of a 33-page specification (including 10-pages of claims (15 claims) and a 1 page Abstract), and 5 sheets of formal drawings (Figs. 1-5)), 3 copies of an Application Transmittal Form, unexecuted Declaration and Power of Attorney, Certified copy of Japanese Application No. 11-269366, Information Disclosure Statement, Form PTO-1449 and copies of the cited information and a check for the $846 filing fee, are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Mail Room Employee
Depositing Express Mail Material

Attorney for Applicant:
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Tel: (212) 278-0400

Application

for

United States Letters Patent

To all whom it may concern:

Be it known that,

Naoki TUMURA

have invented certain new and useful improvements in

A COMMUNICATION TERMINAL AND FACSIMILE
APPARATUS CONNECTED TO AN ANALOG COMMUNICATION
NETWORK AND PROVIDED WITH A POWER MANAGEMENT FEATURE

of which the following is a full, clear and exact description:

TITLE

A COMMUNICATION TERMINAL AND FACSIMILE APPARATUS CONNECTED TO AN ANALOG COMMUNICATION NETWORK AND PROVIDED WITH A POWER MANAGEMENT FEATURE

BACKGROUND

Field

This patent specification relates to a communication terminal and facsimile apparatus, and more particularly to a communication terminal and facsimile apparatus connected to an analog communication network and provided with a power management feature.

Background

With the rapid growth in data communication, including the Internet, small portable communication terminals have came into wide use. When a communication terminal is connected to an analog communication network, such as a public switched telephone network (PSTN), electrical isolation between the network and the internal circuitry of the terminal is needed for protecting against damage to the circuitry in the terminal caused by surge voltage, penetration of common mode noise, etc. A relatively massive isolation transformer has been used for such purposes for a long time.

Such an isolation transformer should convert an input

1

voltage to an output voltage without distortion of a signal
waveform. However, in practice factors such as distortion of an
electromagnetic characteristic of the iron core of the
transformer, can distort the output voltage. Further, as an
isolation transformer is miniaturized, such distortion tends to
increase.

Further, there has been a rapid increase in data
transmission rates in analog communication networks.
Consequently, there is a greater need to reduce distortion of a
transmission signal in order to achieve higher data rate
transmission. That is, the need has been growing for further
reduction in distortion of an analog transmission signal, and the
need for further miniaturization of an isolation transformer also
has been increasing.

More recently, isolation in the analog signal region is
being supplanted by isolation technology in a digital signal
region, in parallel with rapid progress of semiconductor and
insulating material technology. In digital isolation technology,
an analog signal received from an analog communication network is
first converted into a digital signal at a line interface
circuit, and the converted digital signal is used for electrical
isolation in the digital signal region. Similarly, transmitting
digital data is isolated in the digital signal region, and the
isolated digital data is converted into an analog signal and then
transmitted to the analog communication network.

As an example, Japanese Laid-Open Patent Application No.

2

6-98038 discusses a modem with digital isolation that eliminates the need for a relatively large and heavy isolation transformer from a data access arrangement (DAA) and substitutes two relatively small pulse transformers between an integrated analog circuit and a digital signal processor to eliminate analog distortion.

When electrical isolation is achieved in a digital signal region, allowable signal distortion is larger than that achieved in an analog signal region, and therefore a relatively small isolation device, such as a pulse transformer, a photocoupler, etc., can be used. As another example of a small isolating device in a digital signal region, an isolation circuit having a combination of electric capacitors and semiconductor devices is also used. Isolation in a digital signal region eliminates the need for a large and expensive isolation transformer, thereby reducing the size and cost of a communication terminal connected to an analog communication network.

Another pertinent consideration is to reduce the power consumption of a communication terminal, such as a facsimile apparatus. For example, to reduce power consumption, a facsimile apparatus may provide a power-saving state in which electric circuits other than a monitoring circuit are placed in a waiting state or idling state. In the waiting state, the monitoring circuit monitors an incoming call received from the connected network and a manual instruction input by an operator of the apparatus.

3

In a communication terminal providing digital isolation, a
modulated analog communication signal received from a connected
network is first converted into a digital signal by a line
interface circuit as described earlier. The converted digital
5   signal is transmitted to a digital signal processing circuit,
such as a digital signal processor (DSP), after passing through a
digital isolation interface circuit. Through processing by the
digital signal processing circuit, the transmitted digital signal
is demodulated, i.e., reconstituted into original data, i.e.,
10   data before being modulated at a sending terminal, and the
demodulated data is transmitted to a next stage.

Conversely, transmitting data received from a preceding
stage is modulated by the digital signal processing circuit, and
the modulated data is transmitted to the line interface circuit
15   after passing through the digital isolation interface circuit.
Then the modulated digital data is converted into an analog
signal as a modulated communication signal, and the modulated
communication signal is sent out toward a receiving terminal via
the connected analog communication network.

20   The above described digital signal processing circuit also
receives network monitoring signals, such as an incoming call
detection signal, an inverting polarity detection signal, a busy
tone detection signal, etc., from the line interface circuit via
the digital isolation interface circuit. The digital signal
25   processing circuit informs a following processor, such as a main
controller, of the received monitoring signals. Further, the

4

digital signal processing circuit responds to the received monitoring signals with an acknowledgment signal, as necessarily.

Accordingly, the digital signal processing circuit needs to be supplied with electrical power and in operation for receiving the network monitoring signals even in a power-saving state during a waiting state or an idling state of the communication terminal.

When the digital signal processing circuit is in operation, the digital signal processing circuit consumes a relatively large quantity of electric power due to a high speed digital signal processing capability executed by large scale circuitry for modulating and demodulating operations at a modulation and demodulation section.

Consequently, in communication terminals including facsimile apparatuses having isolation in a digital signal region, a power-saving function is not always fully effective because substantial amount of power is consumed by the digital signal processing circuit in a power-saving mode at a waiting state of the communication terminal.

SUMMARY

In view of the above-discussed and other problems, an object of the present disclosure is to provide a novel communication terminal and facsimile apparatus connected to an analog communication network provided with isolation in a digital signal region that can reduce power consumption.

5

To achieve these and other objects, the present disclosure provides a novel communication terminal apparatus connected to an analog communication network that includes a line interface circuit to control the network, convert analog data of network control and monitor signals and a modulated signal received from the network into digital data, and convert digital data including a modulated signal transmitting to the network into analog data. The apparatus also includes a digital signal processing circuit provided with a network control signal processing section and a modulation and demodulation processing section, and a digital interface device to electrically isolate the network control and monitor signals and the modulated digital signals. The apparatus further includes a power-saving control device to carry out the operation of the line interface circuit and the network control signal processing section and suspend the operation of the modulation and demodulation processing section so as to be into a power-saving state when a predetermined power-saving state transit factor has occurred in a normal operating state, and resume the suspended operation of the modulation and demodulation processing section when an incoming call signal is received during the power-saving state.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the

6

following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a block diagram illustrating an exemplary facsimile apparatus having an isolation transformer;

5   FIG. 2 is a block diagram illustrating an exemplary facsimile apparatus without a large isolation transformer;

FIG. 3 is a block diagram illustrating an exemplary modem and digital signal processor (modem/DSP) of FIG. 2 configured according to preferred embodiments;

10   FIG. 4 is a block diagram illustrating an exemplary facsimile apparatus configured according to preferred embodiments; and

FIG. 5 is a block diagram illustrating the modem and digital signal processor (modem/DSP) and the CPU, and signals between thereof in the facsimile apparatus of FIG. 4.

15

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, FIG. 1 is a block diagram illustrating an

20   exemplary facsimile apparatus 1 having an isolation transformer LT. The facsimile apparatus 1 includes a central processing unit (CPU) 2, a read-only memory (ROM) 3, a random access memory (RAM) 4, an operation panel 5, an image scanner 6, an image plotter 7, and an encoder/decoder 8.

7

The facsimile apparatus 1 also includes a power-saving control device 9, an input and output port (I/O port) 10, a modem and digital signal processor (modem/DSP) 11, a modem analog front end (modem/AFE) 12, a data access arrangement (DAA) 13, and a

5   system bus 14. The CPU 2, the ROM 3, the RAM 4, the operation panel 5, the image scanner 6, the image plotter 7, the encoder/decoder 8, the power-saving control device 9, the I/O port 10, and the modem/DSP 11 are interconnected via the system bus 14.

10   The CPU 2 controls the other devices in the facsimile apparatus 1 according to programs or instruction codes stored in the ROM 3 to perform a predetermined facsimile communication operation. The RAM 4 functions as a working memory of the CPU 2, i.e., the RAM 4 stores various data such as control parameters

15   for driving devices and elements in the facsimile apparatus 1, temporary data required for program execution by the CPU 2, etc.

The operation panel 5 displays a status of the facsimile apparatus 1, operation guidance, etc., and inputs instructions to operate the facsimile apparatus 1. The image scanner 6 scans a

20   sending document and generates digital image information. The image plotter 7 forms and outputs an image on a sheet of paper according to received facsimile information.

The encoder/decoder 8 encodes image information of a sending document, which is read by the image scanner 19, into compressed

25   image information. The encoder/decoder 8 also decodes received compressed image information into decompressed image information.

8

The encoder/decoder 8 may also be referred as a coder.

The modem/DSP 11 modulates data sent from the CPU 2, which is sending facsimile data, into modulated digital data by using digital arithmetic and/or logical operation and transmits the modulated digital data to the modem/AFE 12. The modem/DSP 11 also demodulates modulated digital data sent from the modem/AFE 12 into demodulated data also by using digital arithmetic and/or logical operation and sends the demodulated data to the CPU 2 as received facsimile information.

The modem/AFE 12 converts modulated digital data into an analog modulated signal and also converts an analog modulated signal into modulated digital data.

The data access arrangement (DAA) 13, which is also referred as a line interface circuit, includes a primary circuit 20, a secondary circuit 21, an isolation circuit 22, and an isolation transformer or a line transformer denoted by LT. The primary circuit 20 is connected to a telephone network, the line transformer LT, and the isolation circuit 22. The primary circuit 20 functions as a network control unit (NCU). The line transformer LT electrically isolates the telephone network and the internal circuitry of the facsimile apparatus 1 in an analog signal region.

The secondary circuit 21 is disposed between the line transformer LT and the modem/AFE 12. The isolation circuit 22 can be, for example, an electromagnetic relay, a photocoupler, etc. The isolation circuit 22 also electrically isolates the

9

telephone network and the internal circuitry of the facsimile apparatus 1.

The I/O port 10 transmits network control and monitor signals to the primary circuit 20 and also receives network control and monitor signals and the modulated digital signals from the primary circuit 20. Examples of the network control signals such as an incoming call detection signal, a busy tone detection signal, an inverting polarity detection signal, a control signal to make and break a relay of the line loop, etc., are received and transmitted by the I/O port 10. As stated above, the signals transmitted between the primary circuit 20 and the I/O port 10 are electrically isolated by the isolation circuit 22.

The power-saving control device 9 controls power consumption of the facsimile apparatus 1. When the facsimile apparatus 1 is in a waiting state or out of use for a predetermined period, the power-saving control device 9 signals the CPU 2 to change the state of the facsimile apparatus 1 into in a power-saving state. In other words, when the facsimile apparatus 1 is not in a receiving operation of a facsimile massage, a transmitting operation of a facsimile massage, or an instruction inputting operation via the operation panel 5 for a predetermined period, the CPU 2 changes the state of the facsimile apparatus 1 into a power-saving state.

In the power-saving state, the CPU 2 shuts of supplying power, or halts an operating clock signal to devices in the

facsimile apparatus 1 that need not be operated during the power-saving state. For example, a backlight of the display of the operation panel 5, the image scanner 6, the image plotter 7, the encoder/decoder 8, the modem/DSP 11, the modem/AFE 12, etc.,

5   are shut off from being powered or supplied with operating clocks. In other words, the operation of those devices is suspended, and therefore the power consumption is reduced.

During the power-saving state, the CPU 2 transfers the control of those devices under the power-saving control device 9.

10   The power-saving control device carries on the operation of the line interface circuit (i.e., DAA 13), the power-saving control device 9 and the I/O port 10, etc., during the power-saving state.

During the power-saving state, the CPU 2 waits for a

15   return-to-normal operating state signal from the power-saving control device 9. The return-to-normal operating state signal is transmitted to the CPU 2 as an interrupt request signal, which is independent from the system bus 14, i.e., the interrupt request signal does not use the system bus 14.

20   During the power-saving state, when the power-saving control device 9 detects a parameter indicative of a return-to-normal operating state, such as an incoming call detection signal from the DAA 13, a key input signal from the operation panel 5, etc., the power-saving control device 9 generates an active interrupt

25   request signal as a return-to-normal operating state signal to the CPU 2.

11

When the interrupt request signal becomes active, the CPU 2 resumes supplying power or operating clock to the suspended devices, i.e., devices in power saving, such as a backlight of the display of the operation panel 5, the image scanner 6, the image plotter 7, the encoder/decoder 8, the modem/DSP 11, the modem/AFE 12, etc., and thus the facsimile apparatus 1 returns to the normal operating state.

FIG. 2 is a block diagram illustrating an exemplary facsimile apparatus 1A without a line transformer or an isolation transformer. Referring to FIG. 2, the devices that are substantially the same as those in FIG. 1 are denoted by the same reference numerals, and a repeated description of those operational steps is not provided.

Referring to FIG. 2, the facsimile apparatus 1A includes a random access memory (RAM) 4, an operation panel 5, a power-saving control device 9, a modem/DSP 11, a semiconductor data access arrangement (DAA) 13A, and an isolation circuit 30. Further, the facsimile apparatus 1A includes an image scanner, an image plotter, and an encoder/decoder, however those devices are substantially the same as those in the facsimile apparatus 1 of FIG. 1 and therefore those devices are not illustrated.

The semiconductor DAA 13A is also referred as a line interface circuit and includes a primary circuit 20A and a secondary circuit 21A, but does not use a relatively large isolation device, such as the line transformer LT of FIG. 1, to electrically isolate in an analog signal region. The primary

12

circuit 20A includes a network control and monitor unit 31, and
is connected to the telephone network. The network control and
monitor unit 31 functions as a network control unit (NCU). The
secondary circuit 21A includes a modem analog front end
(modem/AFE) 32.

The modem/DSP 11 modulates data received from the CPU 2 into
modulated digital data, which is in a parallel data format in
this example. The modem/DSP 11 then converts the modulated
digital data in the parallel data format into serial data, and
transmits the serial data to the isolation circuit 30. The
modem/DSP 11 also receives modulated serial data from the
isolation circuit 30, and converts the serial data into parallel
data. The modem/DSP 11 demodulates the modulated data into
demodulated data, and sends the demodulated data to the CPU 2 as
received facsimile information. For practicing the above
described serial to parallel and parallel to serial data
conversion, the modem/DSP 11 may provide a serial to parallel and
parallel to serial data converter.

The modem/AFE 32 converts a digital signal received from the
modem/DSP 11 via the isolation circuit 30 into an analog signal
to send the converted data to the telephone network via the
primary circuit 20A. The modem/AFE 32 also converts an analog
signal received from the primary circuit 20A into a digital
signal to send the converted data to the modem/DSP 11 via the
isolation circuit 30.

The isolation circuit 30 electrically isolates the telephone

13

network and the internal circuitry of the facsimile apparatus 1A
in a digital signal region. The isolation circuit 30 may
comprise, for example, a pulse transformer, a photocoupler, etc,
and therefore the isolation circuit 30 can be relatively small
and have a relatively low cost. The data passes through the
isolation circuit 30 in a serial data transmission manner, so
that the isolation circuit 30 can use a single isolating device
and thereby the isolation circuit 30 can be further reduced in
size and cost.

In addition to the facsimile data transmission between the
modem/AFE 32 and the modem/DSP 11, network control signals sent
to and received from the network control and monitor unit 31 pass
through the isolation circuit 30 in the serial data transmission
manner. Further, the modem/DSP 11 has a circuit to relay network
control and monitor signals transmitted between the network
control and monitor unit 31 and the CPU 2. As a part of the
transmission path of the control and monitor signals between the
modem/DSP 11 and the CPU 2, the system bus 14 may be used.

The facsimile apparatus 1A of FIG. 2 can be made smaller and
less expensively than the facsimile apparatus 1 of FIG. 1.
However, unless the modem/DSP 11 is supplied with electric power,
the modem/DSP 11 cannot relay the above-described network control
and monitor signals, such as an incoming call detection signal,
to the CPU 2. Accordingly, even when the facsimile apparatus 1A
is in the power-saving state, the modem/DSP 11 has to be supplied
with electric power to relay the network control and monitor

signals including an incoming call detection signal to the CPU 2 to invoke a receiving operation of the information corresponding to the incoming call.

However, if the whole circuit of the modem/DSP 11 is supplied with electric power in the power-saving state, a portion of the modem/DSP 11 where the modulating and demodulating operations are performed, consumes a certain amount of electric power.

FIG. 3 is a block diagram illustrating an exemplary modem and digital signal processor (modem/DSP) 11 of FIG. 2 configured according to the present invention. Referring to FIG. 3, the modem/DSP 11 includes a CPU interface (CPU-I/F) 40 that interfaces with the CPU 2 of FIG. 2 via the system bus 14, a DAA interface (DAA-I/F) 41 that interfaces with the network control and monitor unit 31 of FIG. 2 via the isolation circuit 30, etc., a modulation and demodulation section 42, a network control signal processing section 43, and a clock signal generator 44.

The CPU-I/F 40, the DAA interface (DAA-I/F) 41, the modulation and demodulation section 42, and the network control signal processing section 43 are clocked with a clock signal generated by the clock signal generator 44.

When the facsimile apparatus 1A is in a power-saving state, the CPU-I/F 40, the DAA interface (DAA-I/F) 41, and the network control signal processing section 43 are required to be in operation; however, operation of the modulation and demodulation section 42 is not required. Accordingly, the clock signal

15

generator 44 generates independently two channels of clock

signals, one is used for supplying the CPU-I/F 40, the DAA

interface (DAA-I/F) 41, and the network control signal processing

section 43, and the other is used for supplying the modulation

5   and demodulation section 42.

The clock signal supplied to the modulation and demodulation

section 42 is halted and resumed according to a power-saving

operation command, which is provided by the CPU 2 through the

CPU-I/F 40. For example, the clock signal generator 44 may have

10   a two-input logical AND gate, and when one of the two inputs is

connected to the generated clock signal and the other input is

connected to the power-saving operation command. Thus, the

output terminal of the AND gate connected to the modulation and

demodulation section 42 follows the power-saving operation

15   command.

When the facsimile apparatus 1A transitions to a

power-saving mode, the CPU 2 generates a power-saving operation

command to halt the clock signal supplied to the modulation and

demodulation section 42. Thereby, the operation of the

20   modulation and demodulation section 42 is suspended or halted,

and thus the power consumption at the modulation and demodulation

section 42 is suppressed.

When the modem/DSP 11 is made of a complementary metal oxide

semiconductor (CMOS) circuit, the consumption power of the

25   circuit is approximately proportional to the operating clock

speed. Therefore, when the clock signal supplied to the

16

modulation and demodulation section 42 is halted, the consumption power thereof becomes close to zero. In addition, the halting and resuming operation of the clock signal does not cause a malfunction of the circuit, i.e., the circuit of the modem/DSP 11 can operate in a stable manner.

Further, instead of halting the clock signal to the modulation and demodulation section 42, the CPU 2 may shut off the electric power supplyied to the modulation and demodulation section 42. This method also suppresses power consumption of the modem/DSP 11 at the power-saving state.

When the facsimile apparatus 1A is in a power-saving state and an incoming call arrives, because the CPU-I/F 40, the DAA interface (DAA-I/F) 41, and the network control signal processing section 43 are powered and in operation, the network control signal processing section 43 can detect the arrival of the incoming call being sent from the semiconductor DAA 13A via the DAA-I/F 41. Then, the network control signal processing section 43 can notify the CPU 2 of the arrival of the incoming call via the CPU-I/F 40. Thus, the CPU 2 can change the facsimile apparatus 1A back to the normal operating state by resuming supplying the clock signal to the suspended modulation and demodulation section 42 to prepare for receiving and demodulating the incoming facsimile data.

FIG. 4 is a block diagram illustrating another exemplary facsimile apparatus 1B configured according to a preferred embodiment. Referring to FIG. 4, the devices that are

17

substantially the same as those in FIG. 2 are denoted by the same reference numerals, and a repeated description of those devices is not provided.

The facsimile apparatus 1B of FIG. 4 includes substantially the same devices as those in the facsimile apparatus 1A of FIG. 2. In the facsimile apparatus 1B of FIG. 4, the modem/DSP 11 is connected with the power-saving control device 9 in response to an incoming call detection signal. The incoming call detection signal is generated at the network control signal processing section 43 in the modem/DSP 11 as illustrated in FIG. 3.

Referring back to FIG. 4, when the facsimile apparatus 1B is in a power-saving state and an incoming call arrives, the network control signal processing section 43 in the modem/DSP 11 detects the arrival of the incoming call. After that, the modem/DSP 11 notifies the power-saving control device 9 of the arrival of the incoming call as an incoming call detection signal. Then, the power-saving control device 9 notifies the CPU 2 of the arrival of the incoming call as an interrupt request signal via an interrupt request line. Thus, the CPU 2 can change the facsimile apparatus 1B back to the normal operating state by resuming supplying the clock signal to the suspended modulation and demodulation section 42 to receive and process the incoming facsimile data.

In this example, the power-saving control device 9 notifies the CPU 2 of the arrival of the incoming call as an interrupt request signal via an interrupt request line. Therefore, in the

18

power-saving state of the facsimile apparatus 1B, the computer

system comprising the system bus 14, the CPU 2, the ROM 3, the

RAM 4, etc., may be operated at a slower clock rate as compared

to the normal operating state. When the computer system is

5   operated at a slow operating clock, the power consumption of the

computer system is reduced. Thus, the power consumption of the

facsimile apparatus 1B during the power-saving state is further

reduced.

Furthermore, when the network control signal processing

10   section 43 in the modem/DSP 11 detects the arrival of the

incoming call, the modem/DSP 11 may directly notify the CPU 2 of

the arrival of the incoming call as an interrupt request signal

via an interrupt request line. Thus, the CPU 2 can change the

facsimile apparatus 1B back to the normal operating state.

15   FIG. 5 is a block diagram illustrating a modem and digital

signal processor (modem/DSP) 11C and signals between thereof in

the facsimile apparatus 1B of FIG. 4. Referring to FIG. 5, the

modem/DSP 11C includes a CPU interface (CPU-I/F) 40 that

interfaces with the CPU 2 of FIG. 4 via the system bus 14, a DAA

20   interface (DAA-I/F) 41 that interfaces with the network control

and monitor unit 31 of FIG. 4 via the isolation circuit 30, etc.,

a modulation and demodulation section 42, a network control

signal processing section 43, and a clock signal generator 44.

Functions of those devices in the modem/DSP 11C are

25   substantially the same as those denoted by the same reference

numerals in FIG. 3, and a repeated description of those devices

19

is not provided.

The modem/DSP 11C is connected to the CPU 2 by a read signal, a write signal, an address bus, and a data bus via the CPU-I/F 40. These signals are connected to the system bus 14 of FIG. 4, therefore those signals are also connected other devices in FIG. 4, such as the read-only memory (ROM) 3, the random access memory (RAM) 4, the operation panel 5, etc. Through the CPU-I/F 40, the modem/DSP 11C is connected to the CPU 2 also by a reset signal, a chip select signal, an interrupt request signal, and serial signals 14B including a serial clock output signal, a serial data input signal, and a serial data output signal.

When the facsimile apparatus 1B of FIG. 4 is in a power-saving state and an incoming call arrives, the network control signal processing section 43 in the modem/DSP 11C detects the arrival of the incoming call. After that, the network control signal processing section 43 internally notifies the CPU-I/F 40 of the arrival of the incoming call as an incoming call detection signal (denoted by INCOMING-CALL DETECTION SIGNAL). Then, the CPU-I/F 40 notifies the CPU 2 of the arrival of the incoming call as an interrupt request signal via the interrupt request signal line (denoted by INTERRUPT REQUEST SIGNAL). Thus, the CPU 2 can change the facsimile apparatus 1B back to the normal operating state by resuming supplying the clock signal to the suspended modulation and demodulation section 42 to receive and process the incoming facsimile data.

When the facsimile apparatus 1B is in the normal operating

20

state, and the CPU-I/F 40 generates and sends an interrupt request signal to the CPU 2 via the interrupt request signal line (INTERRUPT REQUEST SIGNAL), the interrupt request signal is used for invoking an interrupt service program for the modulation and demodulation section 42.

When the CPU 2 receives an interrupt request, the CPU 2 can distinguish between an incoming call arrival or an interrupt service request for the modulation and demodulation section 42 according to the time of the reception of the request. That is, if the CPU 2 receives an interrupt request during a power-saving state, the CPU 2 determines that the request is caused by an arrival of the incoming call. If the CPU 2 receives an interrupt request during a normal operating state, the CPU 2 determines that the request is caused for an interrupt service for the modulation and demodulation section 42. This method is also referred as a time sharing method.

In this example, an output terminal for transmitting an arrival of the incoming call for exclusive use is not needed. Therefore, production costs of the modem/DSP 11 are reduced. Especially, when the modem/DSP 11 is made as an integrated circuit, the number of terminal pins affects the production cost so that even a deletion of a single pin is effective for cost reduction.

Furthermore, when an interrupt request signal is not available, the serial data output signal in the serial signals 14B may also be used instead of the interrupt request signal.

21

This method can also achieve both the transmitting arrival information of an incoming call and the service request for the modulation and demodulation section 42 without adding a terminal pin for exclusive use of the transmitting the arrival information

5   of the incoming call.

The above-described methods and devices are not limited to facsimile apparatuses, but can also apply to communication terminals connected to an analog communication network and provided with a modulating and demodulating device.

10   As described above, the novel communication terminal and facsimile apparatus connected to an analog communication network and provided with a power management feature of the present invention can save power consumption.

Obviously, numerous modifications and variations of the

15   present invention are possible in light of the above teachings. For example, features described for certain embodiments may be combined with other embodiments described herein, and different components can be used. It is therefore to be understood that within the scope of the appended claims, the invention may be

20   practiced otherwise than as specifically described herein.

This document is based on Japanese patent application No. 11-269366 filed in the Japanese Patent Office on September 22, 1999, the entire contents of which are incorporated herein by reference.

WHAT IS CLAIMED:

1. A communication terminal apparatus connected to an analog communication network, the apparatus comprising:

   a line interface circuit configured to connect to the analog communication network and to control the network, convert analog data comprising network control and monitor signals and a modulated signal received from the network into digital data, and convert digital data comprising network control and monitor signals and a modulated signal for transmitting to the network into analog data;

   a digital signal processing circuit configured to comprise a network control signal processing section that receives network control and monitor signals from the line interface circuit and a modulation and demodulation processing section that receives a modulated digital signal from the line interface circuit and transmits a modulated digital signal to the line interface circuit;

   a digital interface device disposed functionally between the line interface circuit and the digital signal processing circuit and configured to electrically isolate the network control and monitor signals and the modulated digital signals; and

   a power-saving control device configured to carry out the operation of the line interface circuit and the network control signal processing section of the digital signal processing circuit and suspend the operation of the modulation and demodulation processing section of the digital signal processing

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26   circuit so as to be into a power-saving state when a

27   predetermined power-saving state change factor has occurred in a

28   normal operating state, and resume the suspended operation of the

29   modulation and demodulation processing section of the digital

30   signal processing circuit when an incoming call signal is

31   received by the line interface circuit and processed by the

32   network control signal processing section of the digital signal

33   processing circuit during the power-saving state.

1   2. The apparatus according to claim 1, further comprising:

2   a clock signal control device configured to halt and resume

3   supplying an operating clock signal to the modulation and

4   demodulation processing section according to an instruction from

5   the power-saving control device;

6   wherein the power-saving control device generates an

7   instruction to the clock signal control device to halt supplying

8   the operating clock signal to the modulation and demodulation

9   processing section so as to halt an operation thereof when the

10   apparatus changes to the power-saving state, and generates an

11   instruction to the clock signal control device to resume

12   supplying the operating clock signal to the modulation and

13   demodulation processing section so as to resume operation thereof

14   when the apparatus returns to the normal operating state.

1   3. The apparatus according to claim 1, further comprising:

2   a dedicated signal line configured to transmit a

24

3   return-to-the normal operating state request signal from the

4   network control signal processing section to the power-saving

5   control device.

1   4. The apparatus according to claim 1, further comprising:

2   a common signal line configured to transmit an interrupt

3   request signal from the modulation and demodulation processing

4   section during the normal operating state, and transmit a

5   return-to-the normal operating state request signal from the

6   network control signal processing section during the power-saving

7   state.

1   5. The apparatus according to claim 1, further comprising:

2   a serial communication line configured to be used for a

3   signal transmission from the modulation and demodulation

4   processing section during the normal operating state, and used

5   for a transmission of a return-to-the normal operating state

6   request signal from the network control signal processing section

7   during the power-saving state.

1   6. A communication terminal apparatus connected to an analog

2   communication network, the apparatus comprising:

3   line interface means for connecting to the analog

4   communication network, controlling the network, converting analog

5   data comprising network control and monitor signals and a

6   modulated signal received from the network into digital data, and

25

7 converting digital data comprising network control and monitor

8 signals and a modulated signal for transmitting to the network

9 into analog data;

10 digital signal processing means comprising a network control

11 signal processing section that receives network control and

12 monitor signals from the line interface means and a modulation

13 and demodulation processing section that receives a modulated

14 digital signal from the line interface means and transmits a

15 modulated digital signal to the line interface means;

16 isolating means disposed functionally between the line

17 interface means and the digital signal processing means, for

18 electrically isolating the network control and monitor signals

19 and the modulated digital signals; and

20 means for carrying out the operation of the line interface

21 means and the network control signal processing section of the

22 digital signal processing means and suspending the operation of

23 the modulation and demodulation processing section of the digital

24 signal processing means so as to be into a power-saving state

25 when a predetermined power-saving state change factor has

26 occurred in a normal operating state, and resuming the suspended

27 operation of the modulation and demodulation processing section

28 of the digital signal processing means when an incoming call

29 signal is received by the line interface means and processed by

30 the network control signal processing section of the digital

31 signal processing means during the power-saving state.

26

1   7. A method for controlling a communication terminal apparatus

2   connected to an analog communication network, the method

3   comprising:

4   waiting for an incoming call from the analog communication

5   network for a predetermined period;

6   carrying out an operation of network control signal

7   processing and suspending an operation of modulation and

8   demodulation processing when the predetermined period has passed

9   without the communication terminal apparatus being in operation;

10   resuming the suspended operation of modulation and

11   demodulation processing when an incoming call from the analog

12   communication network arrives at the communication terminal

13   apparatus;

14   receiving a modulated analog signal from the analog network;

15   converting the received modulated analog signal into a

16   received modulated digital signal;

17   electrically isolating the received modulated digital signal

18   in a digital signal region;

19   demodulating the isolated received modulated digital signal

20   into demodulated digital data.

1   8.   A method of controlling a communication terminal connected

2   to an analog communication network comprising:

3   providing as a part of the communication terminal a digital

4   processor having a subsystem that, when in an active

5   state, demodulates information received from the analog

6   communication network and modulates information for

7   transmission to the analog network system;

8   selectively providing a first control signal indicative of a

9   desired change of the communication processor from a

10   normal state to a waiting state and, in response

11   thereto, changing said digital processor subsystem from

12   an active state in which it demodulates information

13   received from the analog communication network and

14   modulates information for transmission to the analog

15   communication network to a suspended state in which it

16   consumes less power than in the active state;

17 selectively providing a second control signal indicative of

18   a desired change of the communication terminal back to

19   its normal state and, in response thereto, changing

20   said digital processor subsystem back to its active

21   state for receiving and demodulating information from

22   the analog communication network and for modulating and

23   sending information to the analog communication

24   network;

25 thereby saving power by selectively suspending the operation

26   of said digital processor subsystem while retaining an

27   ability to change back to an active state thereof when

28   needed to receive and demodulate information from and

29   to modulate and send information to the analog

30   communication network.

1   9.   A method as in claim 8 in which said digital processor is
2   driven by clock signals and said changing the digital
3   processor subsystem to its suspended state comprises
4   substantially reducing a rate of said clock signals.

1   10.   A method as in claim 8 in which said changing the digital
2   processor subsystem to its suspended state comprises
3   substantially reducing an amount of power supplied to said
4   subsystem.

1   11.   A method as in claim 8 in which said communication terminal
2   further comprises a central processing unit (CPU) having an
3   interrupt request input terminal coupled with said digital
4   processor and to said analog communication network, said CPU
5   responding to an interrupt request on said input terminal
6   when the communication terminal is in its waiting state by
7   providing information initiating said second control signal,
8   but responding to an interrupt request on said input
9   terminal by providing services to said subsystem when the
10   communication terminal is in its normal state.

1   12.   A communication terminal connected to an analog
2   communication network and comprising:
3   a digital signal processor having configured to include a
4   subsystem that, when in an active state, demodulates
5   information received from the analog communication

29

6   network and modulates information for transmission to

7   the analog network system;

8   a source of a first control signal indicative of a desired

9   change of the communication processor from a normal

10   state to a waiting state;

11   a first control circuit coupled to said source of the first

12   control signal and said digital signal processor

13   subsystem and configured to respond to the first

14   control signal by changing said digital signal

15   processor subsystem from an active state in which it

16   demodulates information received from the analog

17   communication network and modulates information for

18   transmission to the analog communication network to a

19   suspended state in which it consumes less power than in

20   the active state;

21   a source of a second control signal indicative of a desired

22   change of the communication terminal back to its normal

23   state;

24   a second control circuit coupled with said source of the

25   second control signal and said digital signal processor

26   subsystem and configured to respond to the second

27   control signal by changing said digital signal

28   processor subsystem back to its active state for

29   receiving and demodulating information from the analog

30   communication network and for modulating and sending

31   information to the analog communication network;

30

32   thereby saving power by selectively suspending the operation

33   of said digital signal processor subsystem while

34   retaining an ability to change back to an active state

35   thereof when needed to receive and demodulate

36   information from and to modulate and send information

37   to the analog communication network.

1   13.   A communication terminal as in claim 12 including a source

2   of clock signal coupled with said digital signal processor

3   to drive the processor and with said first and second

4   control circuits and responding to said control circuits to

5   supply clock signals at a high rate during said active state

6   and at a low rate during said suspended state.

1   14.   A communication terminal as in claim 12 including a circuit

2   configured to supply operating power to said digital signal

3   processor subsystem and with said first and second control

4   circuits and responding to said control circuits to supply

5   higher operating power during said active state and low

6   operating power during said suspended state.

1   15.   A communication terminal as in claim 12 in which said

2   communication terminal further comprises a central

3   processing unit (CPU) having an interrupt request input

4   terminal coupled with said second control circuit and with

5   said analog communication network, said CPU responding to an

31

6   interrupt request on said input terminal when the

7   communication terminal is in its waiting state by providing

8   information initiating said second control signal, but

9   responding to an interrupt request on said input terminal by

10   providing services to said subsystem when the communication

11   terminal is in its normal state.

32

ABSTRACT

A communication terminal apparatus connected to an analog
communication network includes a line interface circuit to
control network functions, convert analog data of network control
and monitor signals and a modulated signal received from the
network into digital data, and convert digital data including a
modulated signal for transmitting to the network into analog
data. The apparatus also includes a digital signal processing
circuit provided with a network control signal processing section
and a modulation and demodulation processing section, and a
digital interface device to electrically isolate the network
control and monitor signals and the modulated digital signals.
The apparatus further includes a power-saving control device to
carry on the operation of the line interface circuit and the
network control signal processing section and suspend the
operation of the modulation and demodulation processing section
so as to be into a power-saving state when a predetermined
power-saving state change factor has occurred in a normal
operating state, and resume the suspended operation of the
modulation and demodulation processing section when an incoming
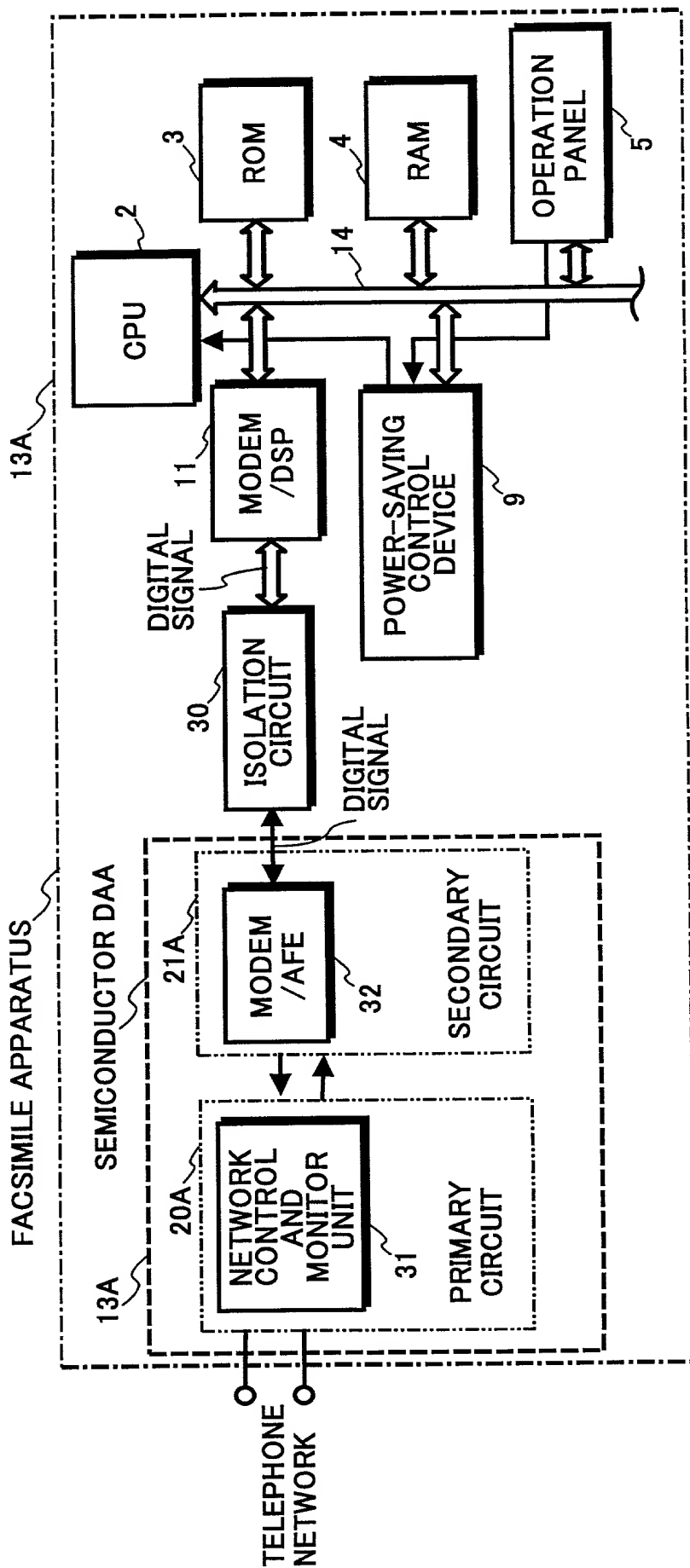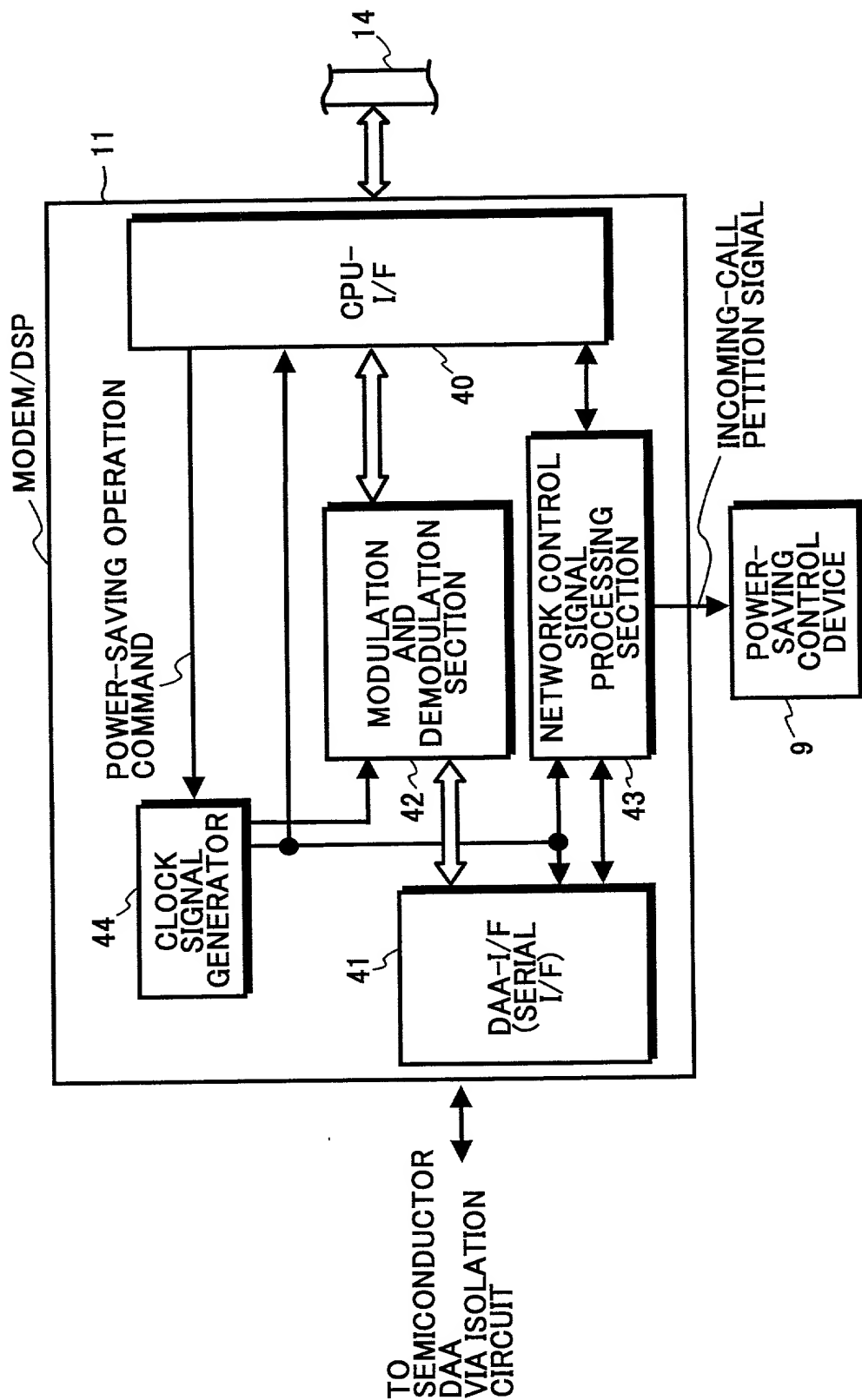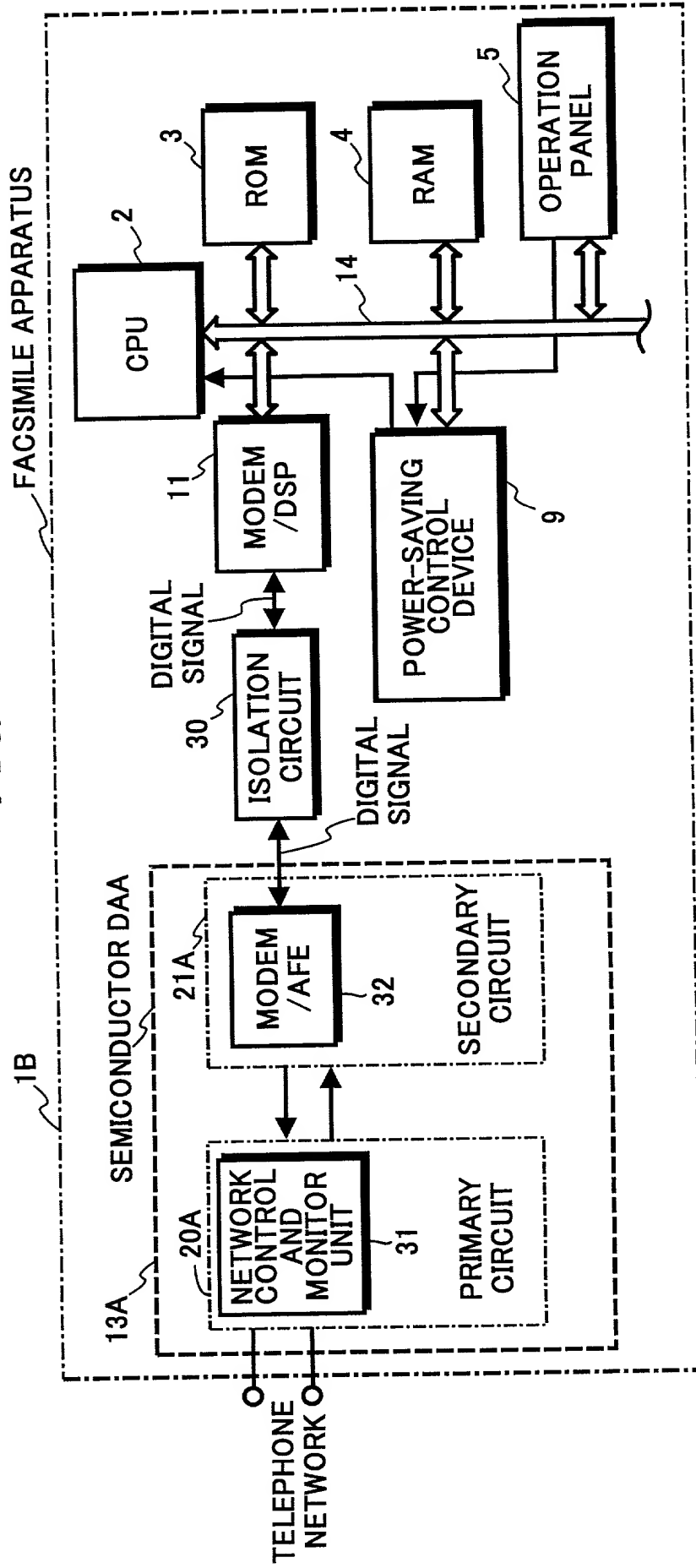call signal is received during the power-saving state.

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FIG. 1

FACSIMILE APPARATUS

FIG. 2

FACSIMILE APPARATUS

ROM 3

RAM 4

OPERATION PANEL 5

CPU 2

13A

14

MODEM /DSP 11

DIGITAL SIGNAL

POWER-SAVING CONTROL DEVICE 9

ISOLATION CIRCUIT 30

DIGITAL SIGNAL

SEMICONDUCTOR DAA

13A

MODEM /AFE 21A

32

SECONDARY CIRCUIT

NETWORK CONTROL AND MONITOR UNIT 20A

31

PRIMARY CIRCUIT

TELEPHONE NETWORK

FIG. 3

MODEM/DSP 11

POWER-SAVING OPERATION COMMAND

CPU-I/F

40

44 CLOCK SIGNAL GENERATOR

MODULATION AND DEMODULATION SECTION

42

NETWORK CONTROL SIGNAL PROCESSING SECTION

43

41 DAA-I/F (SERIAL I/F)

TO SEMICONDUCTOR DAA VIA ISOLATION CIRCUIT

INCOMING-CALL PETITION SIGNAL

POWER-SAVING CONTROL DEVICE

9

FIG. 4

FACSIMILE APPARATUS

FIG. 5

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
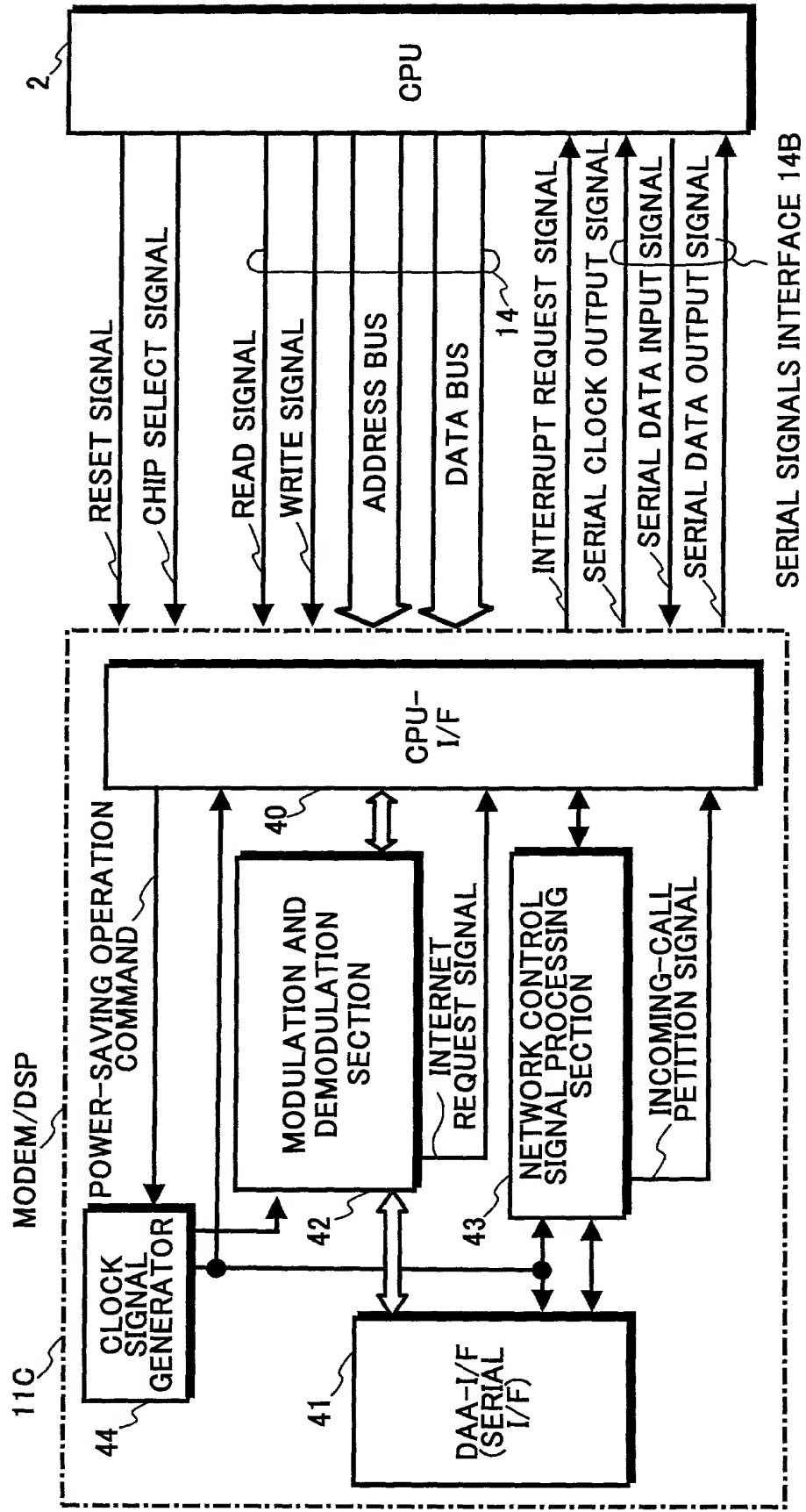
Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

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My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

_____

_____

A COMMUNICATION TERMINAL AND FACSIMILE APPARATUS CONNECTED TO AN ANALOG COMMUNICATION NETWORK AND PROVIDED WITH A POWER MANAGEMENT FEATURE

上記発明の明細書（下記の欄でx印がついていない場合は、本書に添付）は、

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☐ was filed on _____
as United States Application Number or
PCT International Application Number
_____ and was amended on
_____ (if applicable).

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I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第３７編第１条５６項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration
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私は、米国法典第35編119条 (a) - (d) 項又は365条 (b) 項に基き下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365 (a) 項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date *before that of the application on which priority is claimed.*

Prior Foreign Application(s) 外国での先行出願			Priority Not Claimed 優先権主張なし
11-269366 (Number) (番号)	Japan (Country) (国名)	22/09/99 (Day/Month/Year Filed) (出願年月日)	☐
(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	☐

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I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No) (出願番号)	(Filing Date) (出願日)	(Status Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)
(Application No.) (出願番号)	(Filing Date) (出願日)	(Status Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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委任状： 私は下記の発明者として．本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として．下記の者を指名いたします．（弁護士．または代理人の氏名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith *(list name and registration number)*

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（第三以降の共同発明者についても同様に記載し、署名をすること）

(Supply similar information and signature for third and subsequent joint inventors.)